

TROPICAL REGIONS: INFLUENCES ON MILITARY OPERATIONS, PART 2

COLONEL ROBERT H. CLEGG

EDITOR'S NOTE: This article is the second in a two-part series on the tropical regions of the world and their environmental effects on military operations. Part 1, in the March-April 1993 issue, discussed climatic and meteorological conditions, the terrain and vegetation, and the military aspects of the terrain. Part 2 deals with the effects of a tropical environment on soldiers, on equipment and facilities, and on combat and support operations.

This series continues Colonel Clegg's INFANTRY articles on the various regions of the world: "Environmental Influences on Desert Operations" (May-June 1992), and the two-part "Cold Regions: Environmental Influences on Military Operations," co-authored with Brigadier General Peter W. Clegg (July-August and September-October 1992). Colonel Clegg's two-part series on the temperate regions will follow.

Together, these articles provide a complete reference that military leaders can use in preparing their units to operate in any part of the world to which they may be deployed.

The heat and wetness of the tropics take a heavy toll on the soldier, both physically and psychologically. These conditions create an ideal breeding ground for microorganisms that weaken the human body and ultimately kill if precautions are not taken. Various diseases are transmitted by insects or through the water and food the soldiers consume.

During the Buna Campaign in the swamps of New Guinea in World War II, the soldiers of the 32d Infantry Division were plagued by leeches and snakes, jungle rot, and mosquitoes. Their clothing and boots rotted away and could not be replaced. Rain and fog hampered resupply flights. Hot food was simply not possible. Morale was low, and effective strength

was reduced to less than 20 percent. During this campaign, tropical maladies cost the division more than 8,000 of its nearly 11,000 casualties. Most of these (more than 5,000) were from malaria. (See related article on page 18 of this issue.)

Other campaigns in the jungle also show higher casualty rates from sickness than from combat. In the Burma Theater, 90 percent of the casualties were from disease, and in the South Pacific islands, 83 percent were from disease.

In the constant rains of the jungle, sanitation is extremely difficult. Sewage disposal, a major problem in swamps, must be given high priority. Microorganisms that flourish in untreated sewage are transmitted by mosquitoes and flies. The water in which soldiers sit may be stagnant. Their skin softens and is easily broken, even by the tangled undergrowth and elephant grass, and the cuts become infected and can result in amputation or even death.

The best-known tropical disease is malaria. Once infected, a person retains it for life. Although there is no real cure, its effects of nausea and shaking can be controlled. Pills have been developed for various malarial strains, but they have uncomfortable side effects, and soldiers often complain about taking them. It is a leader's responsibility to ensure that soldiers take these pills, even if he has to watch them do it.

Dysentery and diarrhea are also common in the tropics, and typhoid, cholera, hepatitis, schistosomiasis, beriberi, and tuberculosis are additional risks.

Nutrition is the key to keeping up strength. Fresh fruits and vegetables are highly desirable, of course, but their availability in the jungle is limited and the possibility of disease from them is great. Professional food inspection is required before soldiers can be allowed to eat native foods. As monoto-

nous as MREs (meals, ready to eat) may be over a long period, they are at least safe to eat.

Water purification, sanitation, and medication and ointments are the preventive measures for escaping the misery of all these diseases that can render entire armies combat ineffective. Since dehydration and heat injuries can cause casualties, leaders must monitor their soldiers' water consumption. As much as two gallons of water per day per soldier may be required. This is a heavy load to carry, along with ammunition and other supplies, but without potable water, soldiers soon become ineffective. In World War II, exhaustion and heat stroke sapped the soldiers' energy, and a lack of clean water kept them thirsty. The intense sun caused sunburn, and the brightness eventually damaged their eyes. Metal that heated in the sun burned the soldiers' skin when they touched it.

Snakes, leeches, insects, and poisonous plants can incapacitate the unsuspecting soldier. Although these hazards are often exaggerated, a cavalier attitude toward them can also prove deadly. Their psychological effects alone contribute to a lack of attention to other real dangers, such as the enemy.

Excess moisture produces fungi or jungle rot. It causes the skin to deteriorate, making a soldier more susceptible to disease and infection. Trench foot resulting from moisture is as great a risk in tropical regions as it is in cold climates. Since keeping dry is almost impossible, leaders must fully understand what moisture will do and take whatever action is necessary to facilitate drying.

On Leyte in the Philippines, rain fell constantly on the troops. The valleys were flooded, and the ridges and slopes became a morass of mud and slime. The soldiers were exhausted. With insufficient rations and interrupted sleep in water-filled foxholes—not to mention harassing fire from the Japanese—many of them became sick with dysentery, and foot ulcers were common.

In addition to these physical hazards, there are other dangers associated with weather and terrain. Typhoons, with their storm surge, kill hundreds of thousands of people each year. Soldiers can easily be subject to such conditions. Floods from the monsoon and mud slides, along with earthquakes and volcanoes, can wipe out large units much faster than the enemy can.

Psychological effects can also take their toll. The monotony of the tropical climate (brought on by the constant rain and ever-present humidity, heat, and insects) can put soldiers on edge, leading to increased nervousness, lack of motivation, and inactivity. The troops at Buna were described as in a "pitifully abject state incapable of aggressive action." Throughout the tropical campaigns of World War II and the Vietnam War, the ever-present risk of a sniper's bullet added to these psychological effects. Many soldiers experienced "jungle happiness," a condition in which they became unable to adjust later to crowds, bright lights, and even their families.

Life was bleak on the hilltop firebases of Vietnam. The isolation and loneliness played on the minds of the soldiers; the monotony of heat and humidity, coupled with the continuous sound of outgoing rounds, all affected mental stability. The fear of incoming rounds and sapper attacks further

troubled the men at these outposts, and their fears were well-founded. In July 1970, Firebase Ripcord endured a three-week attack by the 6th North Vietnamese Army (NVA) Regiment; 60 Americans were killed and 345 wounded. A single rocket killed 29 and wounded 50 at Firebase Charlie 2. A sapper attack on Firebase MaryAnn killed 30 and wounded 82.

A few days in the swamp reduces the resistance and stamina of even the strongest soldiers. Not only are the injured and sick out of action themselves, but healthy soldiers must stay behind to care for, protect, and transport them. Even the smells of the tropics are an annoyance: Stagnant water, rotting vegetation, and unwashed soldiers, not to mention the stench of death, can be nauseating.

Perhaps the best illustration of the effect of tropical terrain and weather on soldiers is the World War II experience in Burma, where more than 375 inches of rain fell in the four-month wet monsoon (15 inches in one day). Valleys turned into lakes, rivers rose 30 feet in one night, trails turned into ankle deep quagmires and reduced trafficability to one mile per hour. Temperatures reached 130 degrees Fahrenheit and humidity was so bad that breathing became difficult and sleeping almost impossible. The jungle bamboo thickets were so dense that the soldiers had to cut tunnels through them. Fungi and bacteria multiplied at amazing rates causing disease and rot. Mosquitos, flies, leeches, and snakes were ever-present. In this environment, casualties from disease (90 percent from malaria) outnumbered those from combat 14 to 1.

Even the British "Chindits"—who had built endurance by running everywhere, swimming rivers, living on short rations, enduring insect bites, and slogging through mud—lost a third of their force in the jungles of Burma without even meeting the enemy in a major engagement. The soldiers, under British Major General Orde Wingate, headed into the jungle, each carrying a 70-pound load. Although they met with initial success, as they moved deeper and deeper into the jungle the tropical conditions began to take their toll. Potable water became scarce, boots rotted off, and casualties from disease mounted.

Late in 1943, Wingate's force made a second try, this time as part of a larger force. They took the western flank of the three-pronged operation. U.S. Major General Joseph W. Stilwell and his Chinese forces were positioned in the center, flanked to the north and later the east by Merrill's Marauders (under Brigadier General Frank D. Merrill). As in the earlier attempt, the troops penetrated deeply into the jungle, and casualties mounted. Merrill became ill and was temporarily evacuated. Wingate was killed when his plane crashed while returning him to the rear.

Merrill recovered and rejoined his men just in time to lead the assault on Myitkyina, a small jungle village that became key terrain because it had an airfield. Without it, resupply to continue south to coastal Burma and east up into China would have been impossible. Myitkyina was 90 miles away across the rugged Kumon Mountains and through thick jungle vegetation. Although still in the "dry" season, the rain was constant. With the soldiers already in weakened state, the approach march required a superhuman effort. As they climbed

to the 6,100-foot pass, they had to crawl up the slippery steep slopes on their hands and knees. The soldiers, thirsty and intent on drinking, did not boil their water. Many swallowed halazone with water instead of waiting for it to dissolve, thereby exposing themselves to amoebic dysentery and schistosomiasis, both of which could be fatal.

On 16 May the objective was taken. As the Marauders occupied the Japanese positions, the refuse and sewage left behind resulted in typhus, which infected 150. Dysentery plagued 80 percent of the men. About 100 were airlifted out each day, 30 of whom contracted the deadly mite typhus. By the end of May only 200 of the 3,000 Marauders were still able to fight.

Although words are inadequate to describe the misery these men endured, the history of such ordeals must be conveyed to leaders of the future so they can better appreciate the risks of combat in such environments and plan to cope with them.

Effects on Equipment and Facilities

The excessive moisture of the tropics is also a major problem for vehicles, weapons, and other equipment and facilities. The constant wetness of the tropical rain forest and the wet monsoon sub-climate deteriorate equipment quickly, and the severe storms wreck structures. Rust appears quickly on metal and over periods of a few months can weaken equipment and structures and lead to malfunction and collapse. Protective paints and lubricants are therefore critical. Mildew caused by moisture deteriorates fibers, rubber, and leather items. The rains produce mud that gets into moving parts, requiring constant cleaning and lubrication. In the dry monsoon and the savanna sub-climates, dust clogs filters and interferes with components, and they must be cleaned or changed more frequently.

Vehicle coolants and other fluids (particularly in batteries)

need to be replenished regularly because of the high evaporation rates in high temperatures. Rubber gaskets and tires rot. Water gets into fuel lines and oil compartments, and electrical components are likely to short out because of wetness. Also increased engine and transmission wear results from driving in the mud.

Tropical conditions affect all weapon systems. Rifles and guns rust, producing malfunctions and ammunition jams. Cleaning and lubrication are more than daily tasks. Candid photos of soldiers, even generals in these regions, show them cleaning their weapons. Heavy rain and high humidity cause scopes to fog up. Water on a scope glass distorts the target and can cause a miss. Missile munitions are dependent on electrical circuitry, which can short out when it is wet, resulting in misfires and in-flight malfunctions. Shell casings and powder bags must be kept dry and clean. The effectiveness of artillery rounds and missiles is affected by thick vegetation. Tall, multicanopy trees can prematurely detonate fuzes, causing the round to explode too high to be effective. Flares and parachute rounds get snagged in treetops. Fueled munitions burn up trees and shrubs instead of enemy positions. Air-delivered mines may not be distributed as planned because of obstructions from vegetation.

Computers, radios, and other electrical equipment are subject to malfunction because of the humidity and wetness. Parts in radios and sensors rot and short out. Although various radars penetrate clouds, rain, and even vegetation, returns are distorted and weakened, making identification more difficult. The range of radio transmissions is significantly reduced in heavy rain, and interference is a major problem.

Keeping equipment out of the rain is not good enough; the humidity requires that it be covered and protected. Condensation occurs with only a slight drop in temperature, and moisture clings to plastic coverings, inside and out. High tempera-



The mud of delta areas often impedes maneuver, as these 9th Infantry Division soldiers find out on a mission in Vietnam, near Tan Tru, 1968.

Soldiers move through tall grasses during Operation JUST CAUSE, Panama, December 1989.



tures reduce battery life, further complicating communications.

During World War II, communication in the tropics was especially bad. Not only did Japanese artillery constantly cut wire, but standing water in the swamps quickly dissolved insulation, and slight cracks let in moisture that could short out the communications. During many campaigns, communications between adjacent units were nonexistent.

Aircraft are especially reliant on electrical components and mechanical parts and are therefore susceptible to the effects of excessive moisture. High temperatures and less dense air reduce aircraft lift capacity and necessitate longer runways. The movement of artillery by helicopters is problematic. If it is planned for the afternoon when temperatures are the hottest, the helicopters may be unable to lift the tubes. Such missions should be carried out in the early morning hours when the air is as dense as it will get during the day. Sound planning can keep infantry patrols from being without fire support as they move out of range of their initial artillery bases. Fog then becomes a problem that may preclude aviation support. Planning and monitoring of the weather is critical for the simplest routines.

Facilities and other structures such as bridges are subject to weakening and collapse from heavy rains as foundations loosen and support structures shift. Bunkers become cesspools, and sandbags are saturated, endangering the bunkers' structural integrity. The French at Dien Bien Phu, for example, were caught in the wet monsoon (1954) and suffered as their dug-in positions became saturated and important bunkers collapsed.

Most structures in the tropics are fragile, and the high winds associated with tropical storms and typhoons can quickly level them. During the U.S. Army's involvement in Vietnam, such storms wiped out entire compounds. A typhoon in 1971 totally destroyed the headquarters facilities of the 23d Infantry (Americal) Division in Chu Lai.

The savanna is a more stable region, and conditions there are not nearly as harmful to equipment and facilities as the monsoon or tropical rain forest. While the reduced and more seasonal moisture is of less concern, the dryness and high temperatures of the savanna do affect cooling and electronic systems.

Effects on Combat Operations

The jungle is the domain of light infantry. Movement is so restrictive that only the foot soldier can get through. His speed is reduced to a few miles a day because of mud, swamps, steep slopes, thick vegetation, and dense fog and rain. Helicopters provide the mobility required to concentrate combat power quickly at the decisive point. Small ground units, supported by aviation and artillery for firepower, are the norm. This is the environment for air assault operations.

The jungle favors small-scale offensive operations. Concealment is excellent in the thick vegetation, and the weather favors the offense, mainly in the form of ambushes or hit-and-run raids.

The jungle facilitates guerrilla warfare. Insurgents use the thick vegetation, rough terrain, and bad weather to their advantage for concealment and surprise. Counterinsurgency operations also focus on small light infantry and air assault operations.

These operations simply require less logistical support. A patrol carries what it needs to accomplish limited tasks such as surveillance and reconnaissance, interdictions, raids, and ambushes. But these tactics do not exclude offensive operations of battalion, brigade, and even division size and larger. Throughout World War II and the Vietnam War, large-scale campaigns by both sides were decisive. But such offensives are best conducted only after extensive training, planning, and logistical preparations. They should be timed to coincide with favorable environmental conditions. Even in large-

scale offensives, squad, platoon, and company-level actions predominate.

Defensive operations focus on retaining political control of the population, which is mostly concentrated in villages, towns, and some cities. These built-up areas must then be defended. Defensive positions to protect fire and logistics bases are also required. Aggressive tactics are key to a successful defense in the jungle. The insurgent must get close enough to threaten population centers and the defensive positions. Aggressive patrolling keeps the guerrilla on the run. Guerrilla tactics include standoff rocket attacks, ambush, and raids on such key targets as fire bases and ammunition dumps, and on villages and cities.

The objectives in jungle warfare are to kill the enemy, hold key terrain, and control the population. These lessons were learned in Vietnam. Insurgents or guerrillas are dedicated and impelled by ideological or nationalistic fervor. In Vietnam, their "doctrine of struggle" was fueled by hatred of Americans. Since they could rarely be expected to give up their cause, they had to be captured or killed. After active patrols in the jungle had located the enemy, massive firepower (air sorties, naval gunfire, artillery, and attack helicopters) was used against him. The conduct of small-scale operations to find and fix the enemy and the employment of massive firepower required that key terrain be seized and held (the dominant high ground for artillery fire bases, roads and rivers for access, landing zones for infiltration and evacuation). With the enemy on the run and the peripheral key terrain controlled, population centers could then be controlled and protected. Achieving these objectives required persistence but often paid off.

The environment matches the challenge that even a formidable committed force such as the North Vietnamese Army and the Viet Cong provide. The weather does not permit the indiscriminate use of such massive firepower; additionally, the terrain often reduces the effects of munitions. Both the weather and the terrain reduce the freedom of movement of patrols.

On a wet, dreary December day in 1971 in the vicinity of the Hai Van Pass north of Da Nang, 37 soldiers were killed, not by the enemy but by the environment. A Chinook helicopter left Marble Mountain Army Air Field south of Da Nang enroute to Phu Bai and Camp Eagle to the north. Steep mountains rising from sea level to 3,000 feet on the coast separated Da Nang from the two installations. The wet winter monsoon of coastal northern Vietnam produced a thick fog on the mountain tops, and a constant drizzle reduced visibility even further. The fully loaded Chinook disappeared into the mist of the monsoon. The journey was less than two hours but the Chinook never arrived. It crashed into the mountains, which were obscured by the clouds and drizzle. A company of soldiers from Da Nang was immediately dispatched north into the Hai Van along Route 1. They arrived in the suspected vicinity of the crash in about an hour. But it then took five days to search seven kilometers of jungle to find the helicopter and the casualties. The jungle vegetation was so thick, the slopes so steep, and the weather so bad that the urgently pressed troops just could not get there in time to save any of

the soldiers who had survived the crash.

Large-scale operations are hindered even more by trafficability problems. On 20 October 1944, elements of X Corps landed on Leyte in the Philippines. The 5th and 12th Cavalry units entered a deep swamp just beyond the narrow landing beach. Soldiers were up to their armpits in water and had to make three trips just to carry their personal equipment.

The 2d Battalion, 383d Infantry, attacked toward Catmon Hill and also found themselves facing an unsuspected swamp. Their tanks were bogged down and unable to help in the assault. The 1st Battalion of the same regiment also pushed through marshy ground and swamps. Swamps, coconut logs, and other debris limited the advance of the 3d Battalion, 382d Infantry, to only 1,300 meters. To the south, the 7th Infantry Division was also slowed by swamps. Few supplies had been brought forward because the vehicles had moved only 200 meters. Native water buffalo became the only means of transport, and coconuts the only food for the attacking force.

The terrain rather than Japanese resistance jeopardized the operation and the return of General Douglas MacArthur to the Philippines. Once out of the swamp, the 1st Squadron, 5th Cavalry, and other units moved into tall grass and up steep slopes. The hot sun and heavy loads of ammunition led to exhaustion. The 1st Squadron was in particularly bad shape, having advanced for nearly two days without food or water. On the fourth day, Tacloban was secured, and the 5th Cavalry had the honor of welcoming General MacArthur ashore.

On 25 November 1944, the 511th Parachute Infantry Regiment set out. It took until 22 December, nearly an entire month, to complete the movement. Just west of Burauen was the central spine of mountains in Leyte. The slopes rose some 4,000 feet, almost straight up, and the gorges were so deep that they were nearly impassible by foot. Only small foot trails led the way, and these were interrupted by boulder-filled, swift-flowing streams. Logs were used to bridge the creeks, but a slip could mean a 40-foot drop. In some places the slopes were so steep that footholds had to be cut into the hillsides, where drops could be 100 feet.

This terrain, coupled with heavy rains and Japanese snipers, made the crossing dreadful. Only squad-sized units could maintain their integrity. At one point, Company G was cut off without food for four days. The sucking mud, jungle vines, and continuous climb exhausted even the healthiest of the soldiers. The Japanese were concealed by the heavy foliage and took positions in caves. Finally, on 22 December, enemy resistance and, more significantly, the 11 miles of terrain had been overcome. The 187th Glider Infantry Regiment passed through the tired 511th and then the 32d Infantry to continue the attack.

Such environmental conditions greatly influence combat operations. With trafficability so restricted and mobility so important, the helicopter has become the key asset available to facilitate combat operations in the jungle. The battle of the Ia Drang Valley in Vietnam in 1965 was the first significant air assault operation, and air assault tactics and techniques improved throughout the war. Aviators of all services earned their heralded reputation for bravery and risk-taking during



Helicopters—as seen here resupplying 9th Infantry Division units during 1969 operations in Vietnam—are often the most responsive means of resupply in tropical regions.

the Vietnam War. They supported the infantrymen as they flew in less than marginal conditions to deliver reinforcements, evacuate shot-up elements, and engage the enemy with direct fire. Nonetheless, it is primarily the infantry patrol operating under decentralized control that must ultimately root out the enemy, keep him moving—though tired and sick—and kill him.

In Vietnam, infantry platoons set ambushes and conducted raids. They also engaged in defensive operations providing security to villages and combat bases. Patrols and observation posts were the first line of defense. A network of fire bases was behind the patrols and security positions, which provided interlocking indirect fire support, day and night and in all types of weather. They were sitting ducks for enemy raids and rocket fire. Armor also played a role as tanks and armored personnel carriers performed route security and provided defensive direct fire support. These units got their chance to attack in the dry season when their mobility could be exploited.

Another aspect of combat operations is land navigation. In the tropical rain forest, the vegetation and the weather restrict visibility, making land navigation a challenge. In the savanna, dead reckoning is a more effective option. Since compass direction is close to true direction, declination is of less

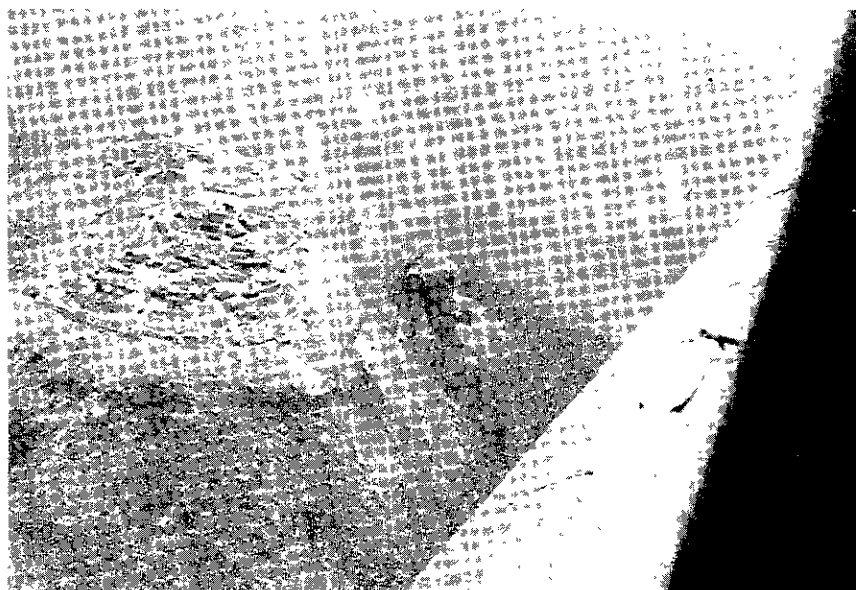
concern; this simplifies movement and calling for fires. The global positioning system (GPS) will greatly assist future jungle operations.

As we have seen, weather and terrain are major factors in the conduct of combat operations in the tropics. Movement is severely hampered, which makes offensive operations difficult; but concealment, leading to surprise—due to both the weather and the terrain—outweighs this handicap. We can conclude that in the tropics the offense is favored, and offensive operations should focus on elements of company size and smaller.

Effects on Support

Logistical support for military operations involves determining the type and quantity of supplies and equipment required (taking into account the unique weather and terrain), establishing supply bases, transporting the supplies, and finally storing and distributing the supplies to the soldiers. Each climatic region presents different challenges to the logistical system. The tropical heat and moisture require special consideration.

In tropical regions, bases are best sited along the coasts



**U.S. Air Force aircraft supports
firebase (west of Da Nang in Vietnam)
with napalm strike.**

where the major cities are found. Such cities have the necessary port facilities and airports to bring in equipment, and the cities can also offer logistical resources. To ensure a dependable resupply for U.S. forces in combat, sea and air control is required in the vicinity of the base. In Vietnam, the U.S. built major supply bases at Da Nang, Cam Rahn Bay, and Long Binh. Access was provided by the construction of port facilities, airfields, and roads.

A good terrain analysis must be conducted before a base is selected. Key terrain such as surrounding high ground must be controlled and vegetation cleared to prevent guerrilla interference with operations. Weather considerations are also critical. Ports must be protected from frequent storms. Protection in this case refers to terrain masking to reduce the effects of wind and waves; the air turbulence often induced by the terrain must be considered. The base will become an enemy objective, as Port Moresby in New Guinea was for the Japanese in World War II, and as the previously mentioned bases in Vietnam were for the NVA and the VC. The NVA and VC always seemed able to identify and target ammunition and petroleum storage areas. (In Da Nang, they even got the base exchange.) The primary base feeds smaller supplemental bases. Supply bases that are far from a secure port or airfield can often be resupplied only in conjunction with a military operation to secure the route. During World War II, for example, Merrill's Marauders took Myitkyina because an airfield existed there and it was needed to supply further operations.

The types of supply include water, food, fuel, ammunition, clothing, engineer materials, spare parts, major end items, and medical supplies. The tropics and jungle warfare have unique requirements for the types of supplies. In Vietnam, technology helped tailor supplies to reduce the effects of tropical conditions and to support the tactics. Food packets for patrols had to be lightweight and nutritious. The bulky and heavy C-rations were replaced by dehydrated rations, which later evolved into today's MREs.

Special ammunition and weapons were developed during the Vietnam War. The M16 was designed for jungle warfare. It was lighter with smaller and lighter ammunition than the M14, the previous standard rifle. The M16 was also semi-automatic and could be made fully automatic for greater and more immediate firepower. Tank rounds were modified to fire area-coverage flechette rounds, which decimated massed formations of NVA and VC as they attacked fire bases and defensive positions.

Such flame munitions as napalm were used in Korea and Vietnam to dislodge a stubborn enemy from dug-in positions and to clear vegetation. During World War II, flame from both man-portable and tank-mounted flamethrowers, was extensively used in the jungles of the South Pacific. Chemicals were also used in Vietnam to defoliate vast areas, thereby denying concealment to the enemy. Large bombs (15,000-pound "Commando Vault") were developed to clear vegetation for helicopter landing zones.

Cargo aircraft became weapon platforms. A 105mm howitzer fired out the rear cargo ramp of the C130, and large-caliber Gatling guns fired from side doors of C123s and even old C47s. Rocket launchers and 7.62mm mini-guns were affixed to helicopters. Strategic bombers (B52s) were used for tactical air support in the "Arclight" program.

New mines were developed to improve security and ambushes. The claymore mine was especially effective as it dispersed a dense pattern of killing pellets. Smaller hand grenades increased throwing range. The M79 grenade launcher was developed to give the rifle squad limited indirect close-in fire support.

Jungle fatigues were developed that were lightweight and dried quickly. These jungle fatigues of Vietnam evolved into the current battledress uniform (BDU), the best field uniform yet. Jungle boots with steel plates in their soles to prevent puncture from punji stakes and quick-drying nylon upper sections to reduce rot were special items that remain in the system. Air holes are part of their design to drain water and

circulate air. (See also "The Army's Family of Boots," by Captain Troy W. Garrett, *INFANTRY*, March-April 1993, pages 7-11.)

Spare parts became modular for quick and easy replacement. Special medicines were developed and made available to the soldiers for use against the various tropical diseases and insects. Helicopter medical evacuation, which had been introduced in the Korean War, was perfected. The UH-1 allowed for treatment during transport. Hundreds of other logistical innovations saved countless lives and made conditions more bearable.

Transporting supplies is a bigger challenge in the jungle. Along coastal flats where roads exist, the main problems are enemy interdiction and bad weather, but tropical areas and steep slopes may reduce ground transport to man and animal packs. Rivers can be used, but riverine craft are vulnerable to ambush from nearly anywhere along the banks. Coastal movement with freighters and tankers is a more secure method for bulk transport. Movement of supplies by air is the easiest and quickest, weather permitting, but quantity and weight restrictions are still major planning factors.

One of the greatest supply challenges in World War II was supporting the resistance to the Japanese in China. The Burma Road and the Ledo-Burma Road were subject to Japanese interdiction and control as well as to torrential monsoon rains. When the roads closed, the only means of transport was by air, and the tropical weather allowed flying only one day in three.

The route over the Himalayas, called "The Hump," consisted of some of the world's most treacherous terrain. The 500-mile journey crossed 15,000-foot jungle-covered mountains. Gorges from tributaries to the Irrawaddy and Mekong Rivers were hundreds of feet deep. Winds recorded at 248 miles per hour flipped over planes in flight and could cause a 3,000-foot drop in altitude. The dirt airfields became another hazard as the rains washed them out and left huge potholes that kept engineers constantly busy. In flying the Hump, 1,000 airmen were killed and 600 planes were lost; however, 650,000 tons of supplies reached General Stilwell's forces fighting their way to Japan through China.

In tropical regions, the heat and humidity also require special storage for many supply items. Perishable medicines and foodstuffs must be refrigerated, which usually requires more fuel oil and gasoline. Special packaging and warehouses are required to keep things dry and prevent spoilage and mildew. Steps must be taken to reduce the damage done by insects and rats. Facilities for long-term storage are limited in the tropics and may have to be built. Getting supplies to the soldiers demands timing and coordination.

The problems our soldiers encountered in the Philippines during World War II illustrate the difficulty of establishing

logistical systems to support combat operations in the tropics. Engineers were charged with the impossible task of constructing a major supply and air base on Leyte. The decision was to make the landings at the beginning of the rainy season. If combat operations were to be successful, the unstable soil, inadequate roads, swollen swamps, and washouts from the heavy rains had to be overcome. High winds and typhoons added to the problems.

The harbor chosen was shallow, and coral reefs restricted the approaches. The base location was at the end of the Leyte Valley, which was interlaced with many streams and flooded rice paddies. Because of the moist soil, tons of crushed stone were required to make the roads trafficable. In the 24th Infantry Division rear area, engineers tried to build a road from the beachhead to an existing coastal road, between which were deep swamps and rice paddies. After a full day, the project was aborted. Once rudimentary airfields and roads were built, maintaining them was a full-time job because of the rain. Road use was ultimately restricted to preserve the lines of communication.

The U.S. Army employs the tenets of AirLand Battle—agility, initiative, depth, and synchronization—better than any other army in the world. Further, the U.S. Army is the world's most adaptable and experienced fighting force. The combat experiences of U.S. soldiers in all the world's climatic regions, including tropical areas, support this claim.

U.S. soldiers and their equipment, tactics, and logistics have overcome the severe conditions imposed by weather and terrain. The Army understands that the environmental effects of each region are unique and tries to account for them. The swamp is still among the worst places to fight and maneuver; the thick jungle is among the most dangerous; the steep slopes are still exhausting; the insects are still both irritating and carriers of disease; and the heat, humidity, and rain are still oppressive.

To overcome these challenges, soldiers must train continually, because training and fitness instill confidence and esprit. Someday, maybe soon, our soldiers will certainly fight again in the tropical jungles. With continuing emphasis and training on the unique conditions of these regions, they will win, in spite of the tropical environment.

Colonel Robert H. Clegg served in Vietnam as a G-2 Air. During Operations DESERT SHIELD and DESERT STORM, he was assigned to the Joint Imagery Production Complex, U.S. Central Command, and previously served as a professor of geography at the United States Military Academy. He is a 1969 ROTC graduate of the University of Rhode Island and holds a doctorate from the University of Maryland. He now commands the U.S. Army Central Security Facility at Fort Meade.

